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## *Marshall Space Flight Center*



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### Remote Determination of Sea Conditions by Electromagnetic Backscatter Measurement

The possibility of using remote electromagnetic backscatter measurements to remotely determine the sea's condition has been investigated. Of primary interest is the effect that the ocean's surface shape has on the near-vertical backscatter. A better understanding is needed of the factors relating electric field to surface shape in order to more accurately predict sea clutter as a source of interference, or to design instruments and data processing procedures for remote sensing of sea conditions and surface winds that produce them.

One formulation of the problem considers the surface to be a stochastic process defined only in terms of probabilities which can be expressed in several ways. For example, the surface can be thought of as facets whose size, shape, orientation, and location are random variables with specified probability distributions. Alternately, the surface can be represented directly in terms of the probability distributions of height, from which the probability distributions of such factors as surface slope and curvature can be derived.

The report covers the statistical character of the surface, the relation between these statistics and electric field, the characteristics of the wave system, and electromagnetic scattering. Since, for many types of random surfaces, field amplitude only contains information on surface-slope variance, other means are required for measuring parameters such as height variance and correlation distance. Because direct measurement of surface height variation implies some kind of phase measuring system, the only alternatives for augmenting amplitude measurement appear

to be systems for (1) measuring variation in surface curvature, or (2) directly measuring correlation distance. These two factors are related in that a large radius of curvature is associated with either small heights or great correlation distances.

There are at least two means of measuring surface curvature: polarization measurements, and specular point (highlight) density measurement. A polarization measurement is not sensitive to the low-frequency components of the surface; a specular point density system requires extremely high angular resolution without which the measurements are not sensitive to the high-frequency components.

In the direct correlation distance measurement system envisioned, the wavelength of the radiation is great relative to the variation in surface height. Although substantial theory exists based on low-frequency approximations (ref.), such very low frequencies do not appear in these applications.

#### Reference:

Cox, D.S.; Munk, W.: Statistics of the Sea Surface Derived from Sun Glitter. *J. Marine Res.*, vol. 13, 1954, pp. 198-227.

#### Note:

Requests for further information may be directed to:

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**Patent status:**

Inquiries about obtaining rights for the commercial use of this invention may be made to:

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